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## A review on therapeutic indications of Jaloukavacharan (medicinal leech therapy)

Tanuja Marotrao Naik and Sumedh Vyankatesh Wasnik \*

*PMT Ayurved College, Shevgaon, Ahmednagar, Maharashtra, India.*

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### Abstract

Since ancient times, Raktmokshana has been one of the best parasurgical therapies indicated in various medico-surgical conditions. It is the course of disposal of vitiated Dosha that collect in the body thus one of the methods of shodhan chikitsa. Among various types of Raktmokshana, jaloukavacharan i.e., leech therapy is more popular now days worldwide. The father of surgery, Acharya Sushruta has described the therapeutic use of leeches. The therapy has been proved absolute safe with obvious advantages which does not cause any unwanted effect. Except hirudin inhibitor of ferment thrombin, there is a whole range of biological active alkaloids combinations. Leech therapy is a good blood purification treatment which has property to die down the aggravation, enlarging, redness and consuming sensation promptly and in which little amount of blood eliminated to vitiated Pitta, Kapha and Rakta dosha of many bloodborne diseases.

Earlier the benefits of leech therapy thought to be derived from the amount of blood lost, hence relieving congestion and removing the noxious humors. But subsequent studies have demonstrated that more than the blood loss, it is the salivary secretions of the leech which contain an amazing cocktail of medicinal substances having therapeutic use in many medical & surgical conditions, to reduce post - operative swelling reconstructive surgery and pain relief in various arthritic diseases.

Leech therapy is exceptionally beneficial therapeutic strategy which gives desired results. So, it is the need of time to spread awareness about leech therapy and its adequacy. It is the elective treatment promising more powerful and secure results for the society.

**Keywords:** Raktmokshana; Jaloukavacharan; Shodhan chikitsa; Leech Therapy; Hirudotherapy

### 1. Introduction

Since ancient time, Raktmokshan i.e., bloodletting is a parasurgical technique practiced worldwide. In Ayurveda, Bloodletting by using leeches are utilized in many medico-surgical conditions, particularly caused because of vitiation of Pitta and Rakta Dosha. It has become popular because of its simple applicability, effortless, painless, absence of genuine intricacies. Jaloukavacharan is particularly valuable in vitiated Raktaja Dosha in Rulers, wealthy people, children, old matured, ladies and people of delicate constitution, it outs vitiated Rakta Dosha from chose part of the body. In shalyatantra (ayurved surgery), bloodletting is considered to be prime treatment [1].

The father of surgery, Acharya Sushruta has described in details about Raktmokshana, the leech therapy is one of them. Raktmokshana Karma (bloodletting) is considered as a regimental therapy which is essential to adopt this procedure in autumn season for purification of body humors, which are otherwise deranged due to seasonal change. Raktmokshana is also indicated in treatment of Raktaja Roga (diseases caused by or affecting the tissues of blood)

\* Corresponding author: Sumedh Vyankatesh Wasnik  
PMT Ayurved College, Shevgaon, Ahmednagar, Maharashtra, India.

Jaloka Avacharana- (medical leech therapy or hirudotherapy), the most delicate method of Raktamokshana which can be applied, unless otherwise contraindicated. The importance of Jalaukacharan can be assessed by the fact that the lord Dhanvantri (the God of Ayurveda) carrying leeches at the time of his origin in the course of Ksheerasagaramantha (churning of Ocean of milk). According to Acharya Charaka, Jalaukacharana as a surgical procedure.

For therapeutic purposes, Leeches are being widely used in and out India. We can find records of the medical usage of leeches' date back to the beginning of civilization. Illustrations of leech application to patients were found in Egyptian tombs dating back to 1500 B.C. There are also references in Greek, Persian, and Arabic literature. The first Western documentation of therapeutic leech use is in the poem Alexipharmaca by Nicander of Colophon in 200 -130 B. C.[2][3].

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## 2. Types of leeches (Jaluka prakar)

In Ayurveda text the Jaloka has been classified in two major varieties based on their therapeutic role -1. The Savisha – toxic (unfit for therapeutic purposes) and 2. Nirvisha – nontoxic (fit for therapeutic purposes).

Nirvish (Non-noxious leeches) are *Kapila, Pingala, Shankamukhi, Mushika, Pundarikamukhi* and *Savarika*. While *Krushna, Karbura, Alagarda, Indrayudha, Samudrika* and *Gochandana* are sorted under noxious leeches. We use *Hirudo medicinalis* for therapeutic purpose [4].

### 2.1. Leech application (Jalaukacharan)

For application of leech, a thick paste of mustard seed and turmeric is applied on leech and it is suspended in solution of turmeric for a Muhurta (approximately 45 min) till they regained their motility. Then the leech is applied on part/area for use. If the leech is unable to stick on the desired spot, then drop of milk or blood is applied on the affected part or slight incision is made on the lesion. After all efforts, if it does not attach itself at the desired spot, it is replaced with other fresh leech. On attachment to the affected part from the suckers, leech assumes Aswakhuravata Ananam, Unnabhya Va Skandham (the shape of a horse shoe in the raised and arched position). At this moment leech is covered with a piece of thin and wet linen or with a piece of white cotton and drops of cool water are frequently dropped on the covering part to provide cooling effect. The leech detaches after completing its feed. Then efforts are made to regurgitate the ingested blood. Subsiding of symptoms of the disease are the signs of proper jaloukacharan. If there is profuse bleeding then for arresting the blood flow, cold water is sprinkled on the lesion and tight bandage is applied. The patient should take adequate rest [5].

### 2.2. Precautions of Leech Therapy

While leech application, Sthoula Madhya (thick in medial part), Pariklishta (ugly), Prithu (flattened), Manda Vichesta (have reduced activity), Agrahi (non grasping), Alpapayi (least blood sucking), Savisha (poisonous leeches), Asamyaka Vamanata (those leeches in which improper vomiting of ingested blood is been done), Pratantama (tired leeches after blood ingestion) and Nipatanata (those leeches who are immotile after blood sucking or by getting used) leeches should be avoided [6].

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## 3. Therapeutic Indications of Jalaukacharan [7]

- In Ayurveda, leech application is indicated in delicate persons like weak patients, female patients, pregnant lady, individual having been satva (mentally weak), ruler, too aged or too young patients.
- leech therapy is mainly indicated in piitaj and raktaj vyadhi.
- Patients suffering from Rakta Pradoshaj vikara (diseases due to vitiation of pitta and rakta dosha). The Rakta - Pradoshaj vikaras are Mukhapaka (erosion in oral cavity), Akshiraga (redness in eyes), Puti Nasa (Smelly secretion from nose or foul smell sensation), Asyagandhata (smelling mouth or smelly secretion from mouth), Gulma (inflammatory condition of abdomen), Upkusha (Bleeding gums), Visarpa (inflammatory skin disorders), Raktapitta (hemorrhagic disorders), Prameelaka (fatigue), Vidradhi (abscess), Raktameha (blood discharge with urine), Pradara (vaginal discharge), Vatashonita (gout), Vaivarnya (discoloration of skin), Agnisada (loss of appetite), Pipasa (excessive thirst), Gurugatrata (heaviness in body), Santapa (febrile condition), Atidurbala (excessive weakness), Tikta Amla Udgara (belching with bitter & acidic taste), Klama (unexplained fatigue), Krodha Prachurya (excessive explained anger), Buddhi Sammoha (confusion), Lavan Asyata (unreasonable excessive salty taste perception), Sweda Sharir Durgandhya (excessive sweating with or without foul odor), Mada (unreasonable compulsive behavior disorders), Kampa (tremors like pathological condition), Swara Kshaya (vocal intensity decreased), Tandra (unexplained mental fatigue), Nidra Atiyoga (excessive sleepiness), Tamaas Atidarshana (unexplained frequent blackouts), Kandu (itching),

- Leeching is found to be very beneficial in Twaka Vikara like Aru, Kotha, Pidika, Kustha, Charmadala etc (skin disorders)
- Specific indications are Gulma (various gastrointestinal diseases) Arsha(piles), Vidradhi, Kustha (various skin diseases) Vatrakta, Galgand (diseases of throat region), Netra vyadhi (eye pain, various diseases of eye) Visha (poisoning and other similar condition) etc.

## 4. Modern applications of leeching[8]

### 4.1. Infectious diseases

Infectious diseases led to a higher usage of the commercially available antibiotics resulting in resistance to antimicrobial agents. Leeching could be effective for the treatment of infection. A protein named destabilase with a lysozyme like activity has been isolated from the medicinal leech extract which shows an antibacterial activity against some bacterial strains. Two agents-theromacin and theromyzin, are isolated from the body fluid of the leech. Both have an antibacterial activity against the Gram positive bacterial strains, The purified extract obtained from any part of leech body, especially salivary glands, showed an antimicrobial activity against many Gram negative/positive pathogens. Leech extract could be used in the treatment of bacteria induced illnesses including infections, arthritis, foodborne disorders, and nosocomial infections. Finally, the salivary gland secretion obtained from the tropical leech *H. manillensis* Is found to have a wide spectrum antibacterial activity against both Gram positive (*S. aureus*) and Gram negative (*Sal. typhi* and *E. coli*) bacterial strains.

### 4.2. Arthritis and analgesic

The painkiller effects of leech application are found in many patients with osteoarthritis claiming that it is more beneficial than conventional analgesics. Likewise, some studies proved that hirudin can reduce synovial inflammation in arthritis patients by inhibiting DING protein, a derivative of synovial stimulatory protein acting as autoantigen in rheumatoid arthritis patients. Moreover, the effectiveness of leech therapy in combination with the traditional herbal formulation has been also assessed. Patients who received the combined treatment displayed less pain and stiffness with better working ability. Other reports indicated leech therapy as an analgesic for iliosacral joints pain and cervicobrachialgia syndrome.

### 4.3. Cardiovascular diseases

It is considered to be the main cause of mortality having 30% of global deaths. Leech therapy has established itself as an alternative remedy for the treatment of vascular disorders. A novel antithrombotic and anticoagulant pharmaceutical preparation was released to the Russian markets "Piyavit", which consisted of the medicinal leech saliva extract having thrombolytic and antiplatelet. It can reduce blood hypercoagulability with an antiinflammatory effect in patients with thrombophlebitis. Likewise, patients with phlebitis who received topical leeching exhibited better walking ability, less pain and minor leg swelling, along with near normal leg skin color. Many therapists used leeches for the healing of hypertension, varicose veins, hemorrhoids, gonarthrosis, and secondary ischemia related dermatosis. The effectiveness of leech saliva in CVDs is the results of specific thrombin inhibitors, hirudin, which was first isolated from *H. medicinalis* and was shown to possess a potent inhibitory effect on both free and clot bound thrombin. Bufrudin was isolated from *H. manillensis* with a chemical structure closely similar to hirudin. A tight binding thrombin inhibitor named haemadin was identified from the whole body extract of the leech species *Haemadipsa sylvestris*. Another antithrombin named granulin like was isolated from the leech species *H. nipponia*. Finally, a human granulocyte and monocyte protein inhibitor known as theromin was characterized from the head extract of *Theromyzon tessulatum* leech species with an antithrombin activity. Noteworthy, hirudin is the only hematophagous animal derived anticoagulant has been approved by FDA for clinical purposes. Hirudin can be used safely in patients with platelet abnormalities or heparin induced thrombocytopenia because it has no immune effects on erythrocytes. Precisely, desirudin is meanwhile in use for the prevention of DVT following hip or knee replacement surgery. A platelet adhesion and activation inhibitor named calin is isolated from the salivary secretion of the European leech *H. medicinalis* and it is believed to act by inhibiting collagen and von Willebrand factor. In addition, saratin from the leech *Haementeria ghilianii* has been described as a platelet aggregation inhibitor via blocking the binding of collagen to integrin  $\alpha_2 \beta_1$  and von Willebrand factor. From a pharmacological point of view, the activated platelet glycoprotein IIb IIIa functions as a receptor for fibrinogen, vitronectin, von Willebrand factor and fibronectin. Therefore, the inhibitors of these surface receptors could be used as medications for the treatment of acute coronary syndrome disease.

#### 4.4. Reconstructive and microsurgery

Microsurgery is aiming to anastomose small blood vessels, veins and arteries during the replantation of tissues or amputated digits. Arterial thrombosis is not common while venous occlusion is a serious threat in newly transplanted tissues and may lead to thrombus formation, stasis, and eventually tissue necrosis. Thus, clinicians argued that relieving venous congestion is a vital step in order to mitigate this risk and to salvage these transplanted tissues. Consequently, not only the active blood drainage that results from the leech sucking action, but also from the passive oozing after leech detachment due to the presence of the long acting anticoagulants in leech saliva motivated medics to use leech to alleviate venous congestion. The relieving effect is the accumulated result of the leech bite induced blood oozing, which is a consequence of many factors, including bleeding wound, secreted bioactive enzyme, anticoagulants, and vasodilators. Surgeons who practice plastic operations considered leeching as a promising remedy, since they observed that the Y shaped wounds caused by leech bites usually heal without scars or complications. Leeching has been reported as a successful remedy to improve blood flow after microsurgery of a severely avulsed scalp. Leeches are also used to decongest completely amputated ears who received replantation and revascularization operations after amputation injuries. Replantation of amputated facial tissues (nasal tips, lower lip, scalp and ears) with microvascular anastomosis achieved a great success and better cosmetic outcomes when venous drainage is augmented by leech application along with arterio venous fistula and pinpricks. Bloodletting by leeches in combination with vascular endothelial growth factor may improve flap survival. Leeching treated patients revealed no edema and normal functions, such as emptying, sensation, and erection. Leech therapy can be successfully applied to avoid venous insufficiency.

#### 4.5. Cancer and metastasis

Cancer is responsible for about 13% of all global deaths. By scientific reports, leech therapy is not established for cancer treatment as a cytotoxic agent. A study was carried out, which were oriented towards using leech saliva and leech extract as antimetastatic agents rather than using it for treating the tumor itself. It is presumed that the extraordinary combination of many anticoagulants, protease inhibitors, and other components in leech saliva could be more powerful as an antimetastatic drug. It is outlined that the salivary gland extract from *H. ghilianii* and *Haementeria officinalis* inhibited the metastatic colonization of lung tumor cells, which were injected intravenously into the experimental animals. Later, an antimetastatic and anticoagulant protein named ghilanten is purified from the salivary gland secretion of the proboscis leech, *H. ghilianii*. It is reported that ghilanten could suppress metastasis. Another research described a synthetic hirudin preparation as an efficacious metastasis inhibitor of a wide range of malignant tumor cells, The Mexican leech *Haementeria officinalis* is subjected to many studies, which eventually led to unveil the antimetastatic activity of its salivary gland secretion. It is observed that its saliva contains a 17 kDa protein, called antistasin, having the capability to prevent lung cancer colonization. Recently, it is evidenced that saliva extract from the tropical leech *H. manillensis* (Lesson, 1842) displayed an antiproliferative activity in vitro against small cell lung cancer (SW1271).

#### 4.6. Diabetes mellitus and its complications

leech application has been used traditionally for the treatment of diabetes complications. Common complications of diabetes is the cardiovascular ones due to coronary atherosclerosis, hyperglycemia, increased blood lipid levels, platelet adhesion disorders, coagulation factors, high blood pressure, oxidative stress, and inflammation. Diabetic patients are at a high risk of myocardial infarction, which is the main death causing reason in type 2 diabetes. The presence of blood affecting peptides and proteins in leech saliva can be of an important benefit for the relieving of these conditions. First of all, hirudin plays an essential role in preventing clotting process because of its ability to bind thrombin and consequently suppress thrombin mediated conversion of fibrinogen into fibrin enabling it to be efficacious for the relieving of ischemic events. Calin, isolated from *H. medicinalis*, has been proven to prevent the formation of thrombi. The peripheral vascular complications in diabetic patients can lead to less blood flow to the parts of the body resulting in ischemic diseases of limbs like gangrene. The aqueous and alcoholic extracts of the whole body of this leech species possessed a potent anticoagulant activity, moreover leeches can prevent amputation. Recently, it is reported that leech saliva from the tropical leech *H. manillensis* possessed an antihyperglycemic activity against alloxan induced diabetes in rats with effective doses ranged from 250 to 500 µg/kg body weight (Unpublished data).

#### 4.7. Dentistry

leech application in dental abnormalities-Traumatic and postoperative macroglossia (tongue swelling) have been associated with life threatening complications, especially, airways occlusion. Leeching is reported to be considerably successful in the management of severe postoperation macroglossia cases when the common treatment method is not satisfactory. Leech therapy in sublingual hematoma and massive lingual hematoma. Other usage of leeches in gum diseases. the direct application of leeches can be a successful remedy for abscess and inflammation.

#### 4.8. Audiology

It is reported that leeches and their salivary secretion are successfully used for the treatment of tinnitus, acute and chronic otitis. Leeching has been applied in sudden hearing loss. In such cases, the therapist used just two leeches; one behind the ear and the other one over the jaw in front of the ear, and the treatment is repeated 2-3 times at intervals of 3-4 days. leeches are proven to be of great benefits in the treatment of this disorder.

#### 4.9. Skin disorders

Leeching has been practiced by traditional therapists for the treatment of skin disorders -infection, inflammation, abscess, allergy, autoimmune conditions etc. with better results.

#### 4.10. Contraindication of Leech Therapy

In Ayurveda text there is no direct description of contraindications of Jaloukavacharan, but the contraindication of Raktamokshan can be considered as contraindications of leech application.

Raktamokshan is contraindicated in patients with Sarvanga Sotha (individual with generalized edema), Ksheenacha Amla Bhojana Nimitta (individuals emaciated due to intake of sour food articles), Pandu Rogi (Anemic Patient), Arsha Rogi (individual suffering hemorrhoids), Udar Rogi (individual with inflammatory disorders of abdomen organs), Shosha Rogi (individual suffering from disorders causing cachexia), Garbhini (pregnant ladies) and Sv athu (individual suffering from inflammatory disorders).

Certain conditions are also mentioned in Ayurveda text when the Raktamokshan should not be performed in indicated patients they are e Duradina (days with rainfall), Sheetavata (breezy day or place), Aswina (without administration of proper swedana) and Bhukta Matre (after intake of complete meals or immediately after meals).

In Ayurveda text immediate status of patients are also mentioned when the Raktamokshan can not administered in indicated patients they are - Mada (delirium), Murcha (unconscious patient), Shrama Artanama (physically exhausted patient), Vata e Vina- Mutra Sangi (patient with holding the urges of flatus, feces & urine), Nidraabhibhota (in sleeping state) and Bheeta (in fearful individual).[9]

#### 4.11. Complications of Leech Therapy

In Ayurveda texts, complications of jaloukavacharan (leech therapy) are not directly mentioned but complication of raktamokshan are mentioned. Bloodletting is done applied in described contraindicated conditions, it causes Shophya (edema), Daha (burning sensation), Raga (redness), Paka (inflammation) and Vedana (pain).

Many studies have shown, infection is the most common complication of leeching and occurs in 2-36% of the patients. Several bacterial strains have been encountered in these infections involving Aeromonas spp., Pseudomonas spp. and Vibrio spp. The main infection causing agent is the Gram positive rod, Aeromonas hydrophila, which can cause pneumonia, muscular necrosis, flap failure and even septicaemia. On the other hand, there is no reports on the leech therapy transmitted diseases, even though, physicians who practice leeching are advised to use a leech once. Local hypersensitivity conditions including itching, blister forming, ulcerative necrosis and even local tissue damage (flap death), which might result from the existence of some toxins in leech saliva. Blood loss because of the prolonged hemorrhage and skin marks (scars) left by impaired healing of leech bites are also reported as late complications.[10]

#### 4.12. Probable mode of action Leech Therapy

As per Ayurveda texts, the probable mode of action of Jaloukavacharan is that due to its capacity of removing Rakta Dhatu along with vitiated Doshas. Rakta Dhatu is the prime carrier of vitiate Pitta in whole of the body. This suggests that the vitiated Pitta Dhatu may be the loads of metabolic waste that is carried along with this circulatory fluid. When this Rakta Dhatu is expelled from the body it carries the vitiated Pitta with itself and thus purifying the body by removal and further decreasing its quantum by compensatory production of healthy Rakta Dhatu, caused due to blood loss. Along with blood Suck, the saliva which contains lots of alkaloids and enzymes of the leech entered in the body causing most effective changes there.[11]

Bioactive compounds like hyaluronidase and collagenase secreted through the leech saliva help open the host tissue upon biting. Following this, leeches have an evolved mechanism to control their host coagulation processes. This is mainly achieved by blocking peripheral nociception effect during the bite to reduce local inflammation as well as producing anti-coagulants, anti-aggregating agents and vasodilating substances to maintain the blood in a fluid state

during intake and subsequent digestion. This is necessary as any stress due to the bite induces a host inflammatory response leading to the migration of large number of leucocytes to the site of injury. Migrations of these leucocytes are undesired because they release protein blood-degrading enzymes. So, by employing the strategy mentioned, leeches can prevent leucocyte migration and in return obtain a long window period necessary for blood meal digestion. Among these inhibitors, hirudin, from a leech species, was the first thrombin inhibitor isolated and studied. Due to the useful bioactive compounds in the leech saliva and the efficient mode of action, leeches have been extensively used for therapeutic purposes [12].

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## 5. Discussion

Jalaukaavacharan is one of the important therapeutic parasurgical procedures mentioned in Ayurveda to treated various medico surgical diseases. It eliminates blood from the body as well as infuses naturally dynamic substances which help to oversee different problems. In Ayurveda, sicknesses are happened by vitiation of dosha which can get amassed in strotas causes blockages and may lead to the illnesses and this could be taken care of by shodhan chikitsa like raktamokshan.

Leech therapy works with waste of watery humor through the trabecular meshwork. As the leeches suck fringe blood it makes negative strain in the vein present locally and works with seepage. Hirudin likewise helps in diminishing the blood thickness, accordingly advancing ideal blood stream and forestalling the dangers related with blood viscosity. Naturally dynamic substance in siphon salivation assists the cells with engrossing essential sustenance & take out poisons. The patients who experience the ill effects of torment and irritation will feel alleviation from the mitigating and sedative impacts of leech's saliva.

With leech application, many infectious and inflammatory conditions can be treated like cardiovascular sicknesses: hypertension. atherosclerosis. hypercoagulation, myocardial areas of localized necrosis, varicose veins, blood vessel blood stream issues in lower appendages and their complexities like trophic injuries and oedemas and furthermore hemorrhoids. It is additionally useful overseeing gynecological issues by decreasing irritation processes in the uterus and genital organs. It is useful in ovarian growths. endometriosis, climacteric condition. different grips in the pelvis and surprisingly in instances of coldness, barrenness and mastopathy. The use of leech is effective in treating prostate and scrotal infections, erectile dysfunctions and urinary conditions.

Additionally, Leech therapy has good outcome to treat different types of cerebral pain. Neurologists ought to consider siphon treatment in the treatment of neuritis. neuralgia, radiculitis, spinal problems. mind atherosclerosis. pre-stroke conditions and stroke. It can bring down glucose levels and work on pancreatic capacity. Leech can be successfully utilized in the coordinated treatment of diabetes and its intricacies. Leech therapy have reported improvements in rest quality, state of mind, work limit and expanded energy levels and ultimately mental health.

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## 6. Conclusion

*Jalaukavcharana* comes under *Raktamokshana* in *Ayurveda*. This is one of the ancient techniques of bloodletting. It is one of the exceptionally viable treatment methodologies for treating different medicosurgical conditions. As indicated by present day science, parasite's salivation contains *Hirudin*, Hyluronidase compound which goes about as anticoagulant, nearby sedative, mitigating, vasodilator, antithrombotic, hypotensive and analgesic impact. Thus, more clinical preliminaries are needed to survey leech adequacy and security in the treatment of other conditions.

The benefits of leech therapy are earlier thought to be derived from the amount of blood lost, hence relieving congestion and removing the noxious humors. But as per current science. Leech salivation contains Hirudin Hyaluronidase chemical which goes about as Anticoagulant, Neighborhood sedative, Mitigating Vasodilator, Antithrombotic, Hypotensive and Pain-relieving impact.

Since ancient time, Leeching is a popular therapeutic practice for a wide range for diseases. Nowadays, leech has come back to the contemporary medicine with fewer applications, which are proven and supported by a huge number of scientific studies and case reports. Hirudo therapy in the field of plastic and reconstructive surgery is expected to be of paramount importance due to the ease of leech application and reduced side-effects. Hence, more efforts should be undertaken to optimize this utilization. More investigations are required also to assess leech efficacy and safety in the treatment of diabetes, cancer and other conditions.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest.

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